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ABSTRACT

Within a longitudinal design, the present study assessed parental attitudes, quality of stimulation in the environment, historical factors, and children's temperament to identify determinants of cognitive ability at 54 months. Children (n=147) were randomly assigned to one of three treatment groups: a center-based intervention, a home-based intervention, or a control group. Maternal IQ and an index of biological risk at birth were measured. Parental attitudes, quality of the home environment, the number of months in day care, and children's temperament were assessed at regular intervals during the preschool years. The analysis strategy was to select the best regression model from the data of the control sample. The model (composed of measures of center day care attendance, an environmental stimulation factor, task orientation, maternal IQ, and a biological risk index) explained 35% of the observed variance in IQ scores of control group children at 54 months of age. Quality of the home and task orientation as measured during infancy made significant independent contributions to this model. This model was then tested with the two other groups, significantly predicting IQ of children in both the home-based and center-based groups at 54 months of age. The environmental stimulation factor demonstrated a significant linear association with IQ in all three groups. Results of this study demonstrate that a multi-level model of the determinants of cognitive performance at 54 months can be successfully constructed and validated, and underline the relationship between environmental stimulation and children's IQ. (Author/BG)

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# Children of Poverty: A Multi-level Analysis of the Determinants of Intellectual Development

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## ABSTRACT

Efforts to identify factors predictive of later intellectual development have frequently produced mixed results. A major reason is that research procedures have not been sensitive to the operation of multiple dimensions of intellectual development. Within a longitudinal design, the present study assessed parental attitudes, quality of stimulation in the environment, historical factors, and children's temperament to identify determinants of cognitive ability at 54 months. Children (n=147) were randomly assigned to one of three treatment groups; a center-based intervention, a home-based intervention, or a control group. Maternal IQ and an index of biological risk at birth were measured. Parental attitudes, quality of the home environment, the number of months in daycare, and children's temperament were assessed at regular intervals during the preschool years. The analysis strategy was to select the best regression model from the data of the control sample. The model (composed of measures of center daycare attendance, an environmental stimulation factor, task orientation, maternal IQ, and a biological risk index) explained 35% of the observed variance in 54 month IQ scores in our control group. Quality of the home and task orientation as measured during infancy made significant independent contributions to this model. This model was then tested with the two other groups, significantly predicting 54 month IQ in both the home-based and center-based group. The environmental stimulation factor demonstrated a significant linear assocation with IQ in all three groups. Results of this study demonstrate that a multi-level model of the determinants of cognitive performance at 54 months can be successfully constructed and validated, and underline the relationship between environmental stimulation and children's IQ.

Efforts to identify factors predictive of later intellectual development have frequently produced mixed results (see Bee, 1982 for a review). A major reason for the conflicting findings is that research procedures have not been sensitive to the operation of the multiple dimensions of intellectual development. Understanding of a slow acting developmental process such as intelligence requires multiple and systematic assessments of relevant characteristics in individuals. The solution proposed here is a longitudinal investigation that is multi-level in conception and design. Based upon both theoretical and research considerations, the present study assessed parental attitudes, quality of stimulation in the environment, historical factors, and children's temperament to identify determinants of cognitive ability at 54 months.

The sample was part of a longitudinal study designed to examine the effects of early intervention on the cognitive development of children identified as at risk for mild mental retardation due to socio-economic factors. At birth, 147 children were randomly assigned to one of three groups, a center-based intervention group, a home-based intervention group, or a control group. Many of the children in the home-based intervention and control group attended other daycare centers for at least some of their preschool years.

Measures of maternal IQ and an index of biological risk reflected historical factors in children's development. Other characteristics of the children and their environments were assessed at regular intervals (see Table 1). Parental attitudes were assessed with the Parental Attitude Research Inventory (PARI) (Schaeffer and Bell, 1958), while stimulation in the environment was evaluated by Caldwell's Home Observation for Measurement of the Environment (HOME) and the number of months each child attended a daycare center. Children's temperament was measured with the Infant Behavior Record (IBR) of the Bayley Scales of Infant Development. The HOME and IBR subscales were summarized by performing a factor analysis on each set of scores resulting in

factors which were easily interpreted as reflecting important aspects of the home environment and infant's temperament, respectively. Children's intelligence was measured at 54 months using the McCarthy Scales of Children's Ability.

Fourteen variables (see table 1), representing the four theoretical factors were entered into a stepwise regression to describe intellectual levels at 54 months. The analysis strategy was to select the best regression model from the data of the control sample. The generalizability of this model was tested by fitting it upon two independent groups.

The selected model reflected a compromise between the desire to explain the greatest amount of variance while retaining the fewest variables. This model (composed of measures of center daycare attendance, an environmental stimulation factor, task orientation, maternal IQ, and a biological risk index) explained 35% of the observed variance in 54 month IQ scores in our control sample. An overall test of this model demonstrated that it was highly significant, $F(5,55) = 5.86$, $p = .0002$. Quality of the home and task orientation as measured during infancy made significant ($p$ .05) independent contributions to this model. This model was then tested with two other groups. The model fit the data of the children receiving home-based intervention extremely well by explaining 57% of the variance in IQ scores. Once again, the quality of the home environment and task orientation variables contributed a significant ($p = .004$ and $p = .043$ respectively) and independent amount of explained variance. The model significantly predicted the 54 month IQ scores of the children in the center-based intervention group, explaining 29% of the variance. Analysis of independent contribution among the variables in the model showed that although task orientation was not significant ($p = .37$), maternal IQ in this sample made a marginally significant impact ($p = .054$). However, the environmental stimulation factor continued to demonstrate the greatest linear association with IQ ($p = .012$).

The results of this study demonstrate that a multi-level model of the determinants of cognitive performance at 54 months can be successfully constructed and validated. This model, based on a thorough and systematic analysis of 4 general factors in children's development, was shown to be robust when validated on two separate samples. Additionally, the finding that the environmental stimulation factor demonstrated the greatest association with IQ can help direct the efforts of those interested in maximizing children's performance.

TABLE 1

OUTCOME AND PREDICTOR VARIABLES FOR THE THREE SAMPLES
COMPOSITE AND ORIGINAL VARIABLES

| VARIABLES | GROUP | | | | | |
|---|---|---|---|---|---|---|
| | CONTROL (N=66) | | FPG DAYCARE (N=61) | | PARENT ED (N=22) | |
| | MEAN | SD | MEAN | SD | MEAN | SD |
| MCCARTHY SCALE INDEX | | | | | | |
| GENERAL COGNITIVE | 93.03 | 12.26 | 101.45 | 10.01 | 89.71 | 13.24 |
| BIOLOGICAL RISK | .77 | .42 | .63 | .48 | .79 | .41 |
| WT IN KG AT BIRTH | 3.21 | .59 | 3.16 | .61 | 3.13 | 1.23 |
| APGAR SCORE-1 MIN | 7.69 | 1.32 | 7.64 | 1.86 | 7.88 | .99 |
| TASK ORIENTATION/IBR COMPOSITE SCORE | 20.41 | 2.63 | 21.66 | 2.49 | 20.42 | 2.47 |
| @ 6 MOS | 19.59 | 4.46 | 19.87 | 3.83 | 20.38 | 4.69 |
| @ 12 MOS | 20.86 | 3.29 | 21.89 | 3.52 | 21.71 | 3.07 |
| @ 18 MOS | 20.77 | 4.05 | 23.24 | 3.58 | 19.04 | 2.71 |
| LEVEL OF ACTIVITY/IBR COMPOSITE SCORE | 13.30 | 2.58 | 13.71 | 2.18 | 13.95 | 2.22 |
| @ 6 MOS | 11.80 | 3.35 | 12.38 | 2.68 | 13.09 | 2.09 |
| @ 12 MOS | 12.95 | 3.53 | 14.06 | 3.22 | 13.71 | 2.46 |
| @ 18 MOS | 15.06 | 3.80 | 14.56 | 3.39 | 15.00 | 3.95 |
| LEVEL OF COOPERATION/IBR COMPOSITE SCORE | 25.52 | 4.04 | 27.12 | 3.14 | 25.56 | 3.48 |
| @ 6 MOS | 25.55 | 5.24 | 26.66 | 4.50 | 27.39 | 4.42 |
| @ 12 MOS | 25.95 | 5.72 | 27.21 | 5.50 | 25.13 | 5.87 |
| @ 18 MOS | 25.11 | 5.88 | 27.60 | 4.90 | 24.43 | 5.40 |
| PARI MATERNAL DEMOCRATIC ATTITUDE COMPOSITE SCORE | 61.38 | 6.57 | 62.19 | 6.36 | 62.31 | 6.77 |
| @ 6 MOS | 61.03 | 7.67 | 61.42 | 7.45 | 62.50 | 7.37 |
| @ 18 MOS | 61.75 | 6.56 | 62.97 | 6.12 | 61.91 | 7.22 |
| PARI MATERNAL AUTHORITARIAN ATTITUDE COMPOSITE SCORE | 39.43 | 9.32 | 37.74 | 8.74 | 37.10 | 9.91 |
| @ 6 MOS | 39.98 | 10.19 | 39.32 | 9.93 | 36.75 | 10.37 |
| @ 18 MOS | 38.95 | 10.57 | 36.16 | 9.18 | 36.96 | 10.12 |
| PARI MATERNAL HOSTILITY COMPOSITE SCORE | 52.31 | 7.48 | 53.73 | 6.78 | 53.40 | 8.90 |
| @ 6 MOS | 51.71 | 8.32 | 52.27 | 7.80 | 51.79 | 9.99 |
| @ 18 MOS | 52.83 | 8.90 | 55.18 | 7.88 | 54.74 | 8.50 |

| VARIABLES | GROUP | | | | | |
|---|---|---|---|---|---|---|
| | CONTROL (N=66) | | FPG DAYCARE (N=61) | | PARENT ED (N=22) | |
| | MEAN | SD | MEAN | SD | MEAN | SD |
| *HOME FACTOR-PRESCHOOL ENVIRONMENTAL STIMULATION | -.67 | 8.58 | .69 | 7.67 | -.03 | 8.37 |
| ORGANIZATION OF ENVIRONMENT | | | | | | |
| @ 18 MOS | .01 | .95 | .11 | .81 | -.37 | 1.47 |
| @ 30 MOS | -.14 | 1.03 | .07 | .94 | .23 | 1.01 |
| PROVISION OF APPROPRIATE TOYS | | | | | | |
| @ 18 MOS | .01 | .94 | -.14 | 1.15 | .31 | .60 |
| @ 30 MOS | .00 | .98 | -.09 | 1.08 | .28 | .82 |
| MATERNAL INVOLVEMENT WITH CHILD | | | | | | |
| @ 30 MOS | .06 | .89 | -.06 | 1.05 | -.04 | 1.16 |
| EQUIPMENT, TOYS, EXPERIENCES | | | | | | |
| @ 42 MOS | -.06 | 1.04 | .10 | 1.06 | -.11 | .72 |
| @ 54 MOS | -.06 | 1.02 | .13 | 1.04 | -.15 | .85 |
| PRIDE, AFFECTION | | | | | | |
| @ 42 MOS | -.03 | .92 | .11 | .98 | -.11 | 1.23 |
| @ 54 MOS | .09 | 1.09 | -.04 | .93 | -.09 | .92 |
| STIMULATION OF MATURE BEHAVIOR | | | | | | |
| @ 42 MOS | -.15 | 1.07 | .14 | .82 | .06 | 1.23 |
| @ 54 MOS | -.15 | .99 | .31 | .71 | -.44 | 1.38 |
| PHYSICAL AND LANGUAGE STIMULATION | | | | | | |
| @ 42 MOS | -.15 | 1.16 | .05 | .86 | .24 | .83 |
| @ 54 MOS | -.11 | .99 | .03 | 1.00 | .17 | 1.05 |
| *HOME FACTOR-INFANT MATERNAL INVOLVEMENT | -.14 | 4.86 | .27 | 4.45 | -.36 | 5.80 |
| MATERNAL WARMTH | | | | | | |
| @ 6 MOS | .08 | .98 | -.09 | .97 | -.03 | 1.14 |
| @ 18 MOS | -.11 | 1.05 | .15 | .88 | -.13 | 1.13 |
| @ 30 MOS | .02 | .91 | -.01 | 1.08 | -.11 | 1.04 |
| ABSENCE OF PUNISHMENT | | | | | | |
| @ 6 MOS | -.01 | 1.06 | .12 | .76 | -.20 | 1.12 |
| PROVISION OF APPROPRIATE TOYS | | | | | | |
| @ 6 MOS | -.05 | .95 | .09 | 1.01 | -.13 | 1.14 |
| MATERNAL INVOLVEMENT WITH CHILD | | | | | | |
| @ 6 MOS | -.02 | 1.01 | .06 | .94 | -.12 | 1.13 |
| @ 18 MOS | -.04 | 1.03 | .02 | .93 | .07 | 1.09 |
| INDEPENDENCE FROM PARENTAL CONTROL | | | | | | |
| @ 42 MOS | -.02 | 1.01 | -.08 | .99 | .28 | 1.00 |

| VARIABLES | GROUP | | | | | |
|---|---|---|---|---|---|---|
| | CONTROL (N=66) | | FPG DAYCARE (N=61) | | PARENT ED (N=22) | |
| | MEAN | SD | MEAN | SD | MEAN | SD |
| *HOME FACTOR-INFANT ENVIRONMENT STIMULATION | -.18 | 4.37 | .14 | 4.50 | -.20 | 3.86 |
| ORGANIZATION OF THE ENVIRONMENT | | | | | | |
| @ 6 MOS | -.04 | .99 | .13 | .97 | -.31 | 1.03 |
| @ 18 MOS | .01 | .95 | .11 | .81 | -.37 | 1.47 |
| OPPORTUNITY FOR VARIETY | | | | | | |
| @ 6 MOS | -.08 | 1.03 | .10 | .99 | -.08 | .97 |
| @ 18 MOS | -.07 | 1.02 | .06 | .94 | -.05 | 1.08 |
| @ 30 MOS | -.01 | 1.02 | -.02 | 1.00 | .04 | .86 |
| PROVISION OF APPROPRIATE TOYS | | | | | | |
| @ 18 MOS | .01 | .95 | -.14 | 1.15 | .31 | .60 |
| @ 30 MOS | .00 | .98 | -.09 | 1.08 | .28 | .82 |
| *HOME FACTOR-ABSENCE OF PUNISHMENT | .16 | 2.79 | .29 | 2.79 | -.78 | 3.75 |
| ABSENCE OF PUNISHMENT | | | | | | |
| @ 18 MOS | .02 | .97 | .13 | .95 | -.26 | 1.07 |
| @ 30 MOS | .00 | .87 | .11 | .98 | -.23 | 1.35 |
| AVOID RESTRICTION | | | | | | |
| @ 42 MOS | .08 | .88 | -.01 | 1.09 | -.14 | 1.10 |
| PRIDE, AFFECTION | | | | | | |
| @ 42 MOS | -.03 | .92 | .11 | .98 | -.11 | 1.23 |
| @ 54 MOS | .09 | 1.09 | -.04 | .93 | -.09 | .92 |
| *HOME FACTOR-MASCULINE STIMULATION | .11 | 1.55 | -.31 | 1.73 | .49 | 1.66 |
| MASCULINE STIMULATION | | | | | | |
| @ 42 MOS | .12 | .88 | -.21 | 1.06 | .23 | 1.05 |
| @ 54 MOS | .00 | .96 | -.12 | 1.07 | .25 | .90 |
| MONTHS IN CENTER-BASED DAYCARE | 21.06 | 12.26 | 16.12 | 16.71 | 51.00 | .00 |

* SCORES ARE STANDARDIZED WITHIN THE ENTIRE SAMPLE OF 147 CHILDREN